Future Soldier System – Objective Force Warrior

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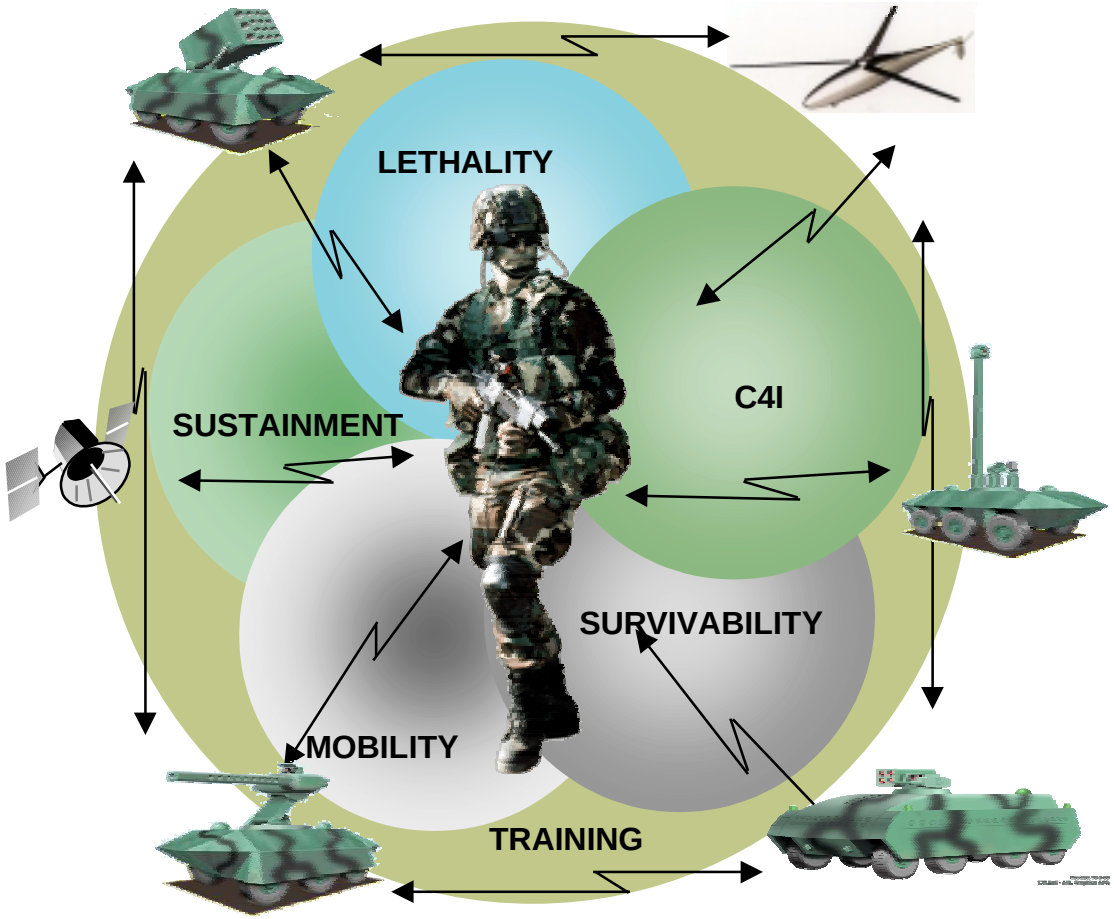
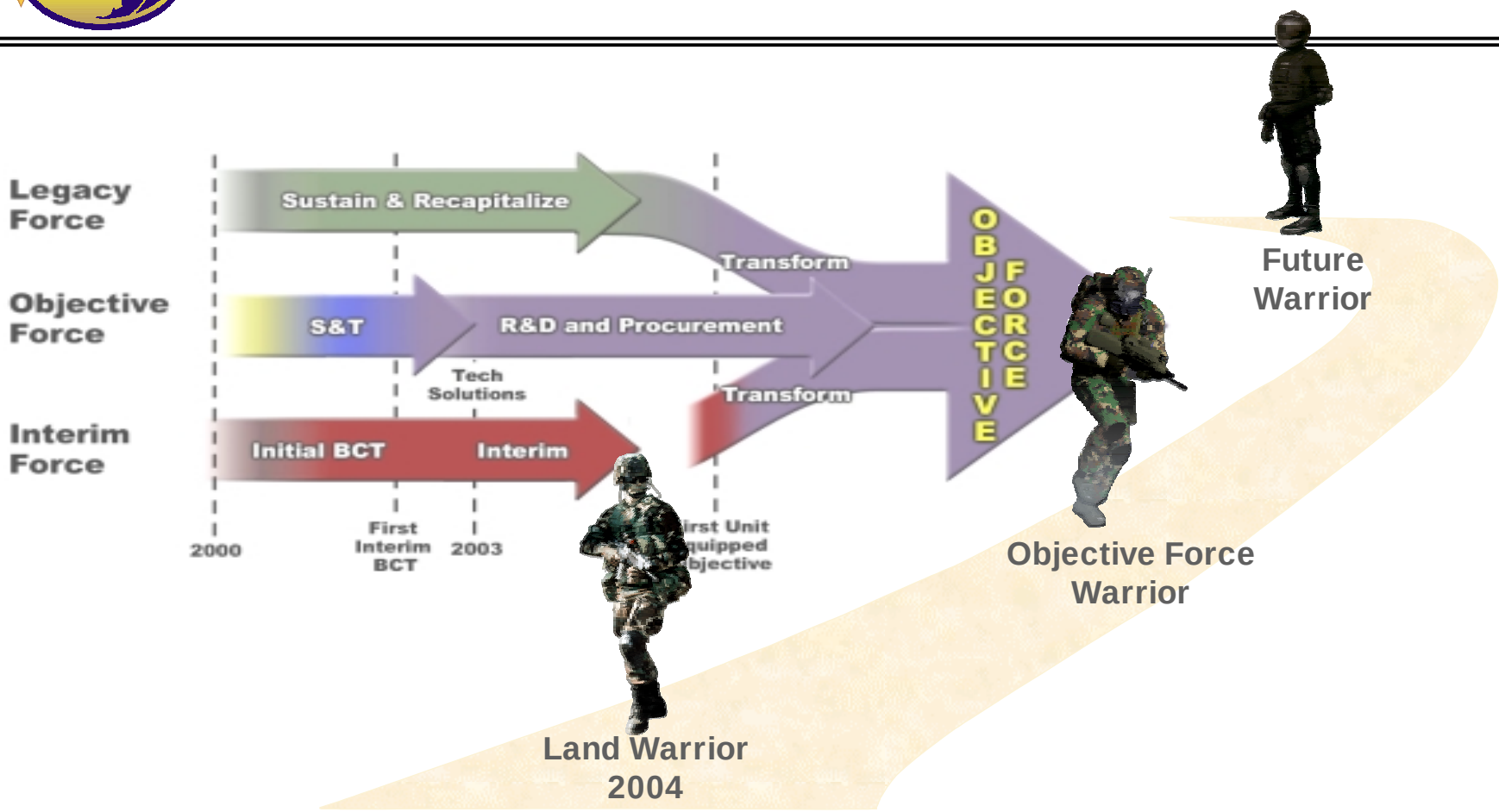
The Army's Objective Force Is…



…Soldier-Centric

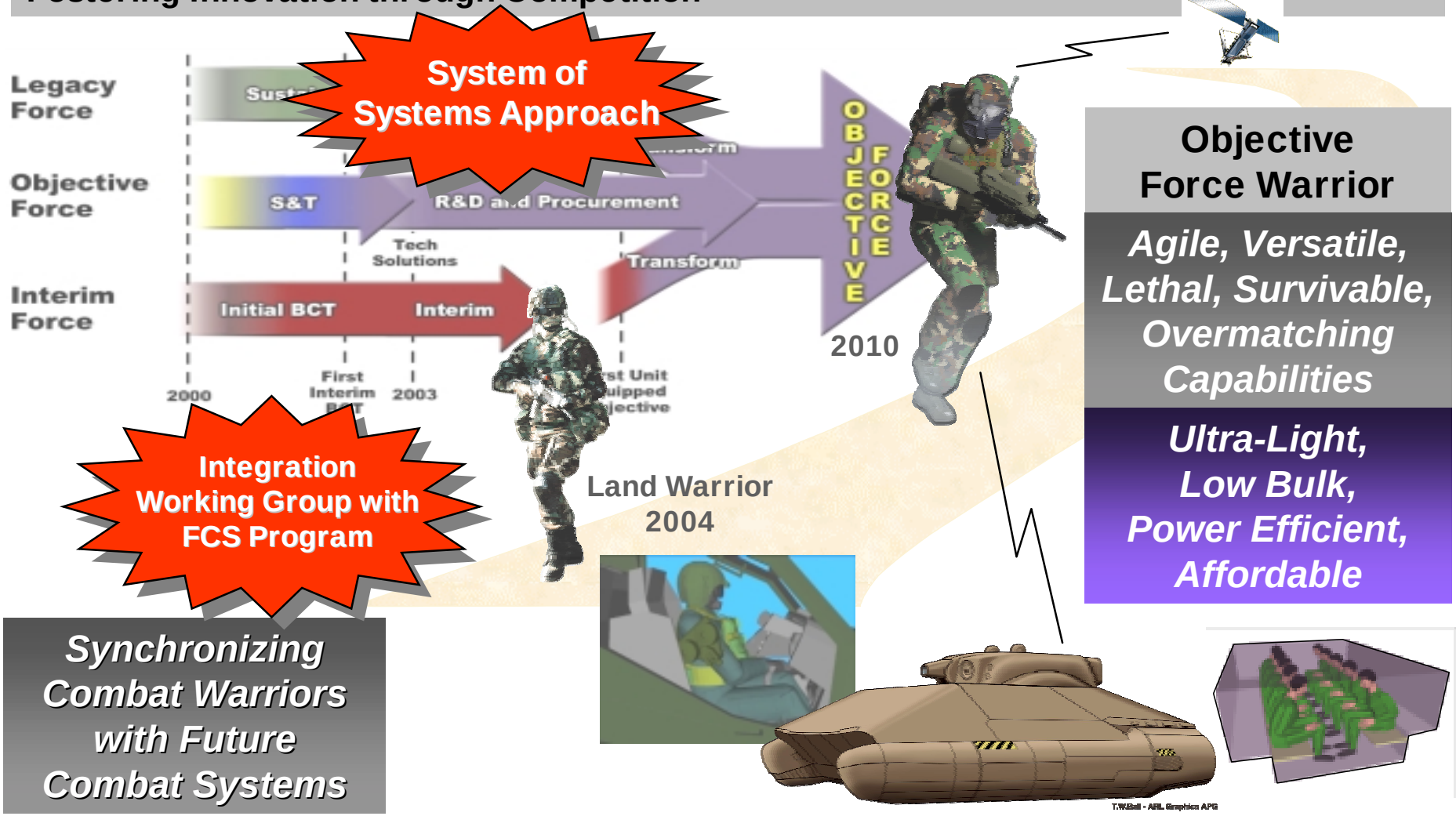
The Warrior System: Supporting Army Transformation



. . . Responsive, Deployable, Agile, Versatile, Lethal, Survivable, Sustainable.

Objective Force Warrior

Project Objective: - Demonstrate Revolutionary, Integrated Warrior Systems as the "Centerpiece of the Objective Force Formation", Accelerating Key Technologies & Fostering Innovation through Competition



Objective Force Warrior
Complex "System of Systems" Integration

Power & Energy

–Extend System Operation from 12 hrs to 72 hrs (Goal) without replacing or renewing energy source (not including cooling)

Weight Reduction

– Drive down System Weight from 92 pounds, leading to 35% of body weight

Affordability

– Reduce Total Ownership Costs by 50% (Stretch Goal)

Balance Weight, Power, Cost & Performance

Human Performance & Integration

Competitive System Design Teams

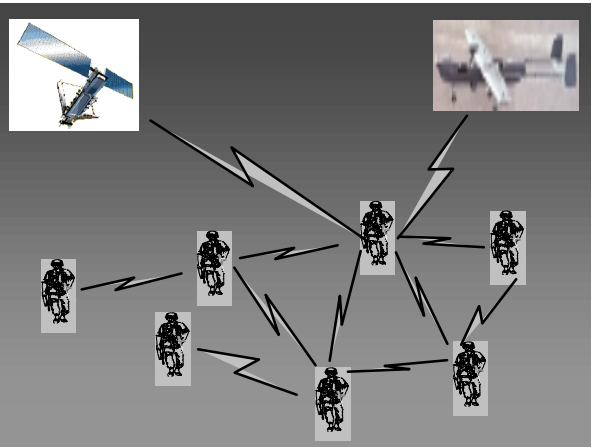
Smart Incorporation of Revolutionary Technologies

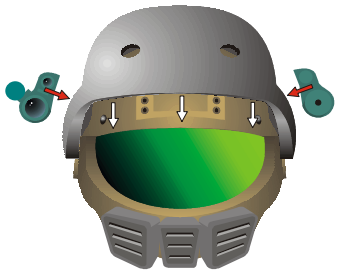
Full Spectrum of Missions, Environments & Threats

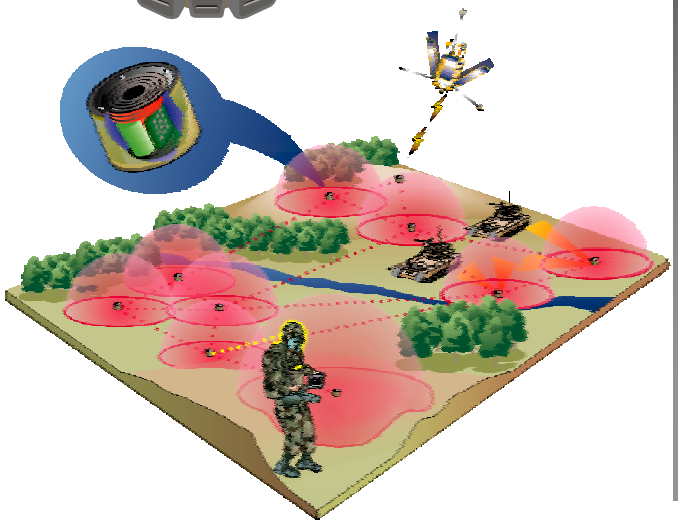
"Network-Centric" Sensors, Communications & Power

Robust, Secure, Adaptable Communications

- Adapted for Objective Force Operations in Complex Terrain (MOUT)
- Selectable, Robust Bandwidth & Range
- Frequency Agility
- Self-Organizing, Ad-Hoc Networks
- Relays through Warrior, Space, Micro-UAV, UGV and/or Unattended Sensor Assets







Overmatching Sensors – System of Systems

- Multi-Functional, Unattended Micro-Sensors (Multi-Spectral Imaging, Seismic, Acoustic, Magnetic, Fusion & Comms Relay)
- Headborne, Multi-Spectral Image Fusion
- Physiological & Medical
- Chem/Bio & Laser Warning
- Counter-Sniper & Counter-Mine

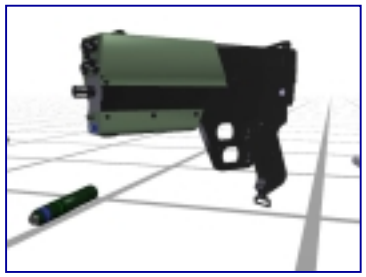
Revolutionary Power Sources

- Advanced, Hybrid Fuel Cells
- Nano-Particle Polymer Photo-Voltaic
- Leverage DARPA Palm Power

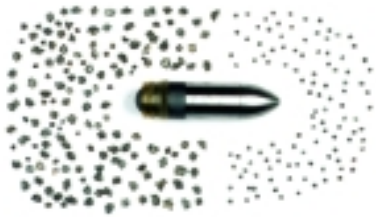
Integrated, Lightweight Weapons & Fire Control Capability

Highly Accurate & Lethal in Complex Terrain / Urban Environments

MEMS Miniature Electro- Mechanical Fuzing



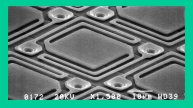
Embedded Simulation



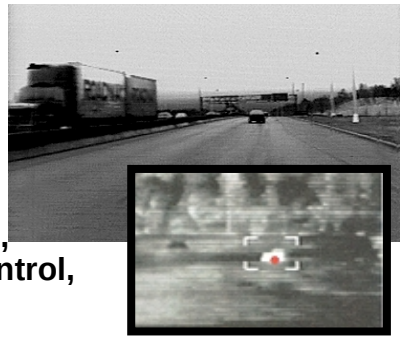
Directed Fragmentation

Low Cost, Lightweight Air-Bursting Munitions

Low Cost Sensors through Dual Use - Commercial Volume



VO_x Microbridge Uncooled FPA



Uncooled Thermal, Integrated Fire Control, Target Tracker & Laser Steering

Modular & Multifunctional

20-70% Reduction in Weapon Weight

0-7X Increase in Lethality

Dominant Close Combat Power

Integrated Protection Ensembles
"Scorpion"

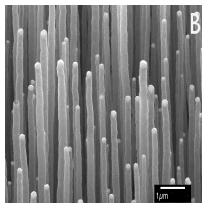
Revolutionary Design Paradigm
Highly Integrated & Multi-Functional
Modular for Mission Flexibility
Combined "Head-to-Toe" Protection
(Ballistic, Laser Eye, Chem/Bio, Environmental)
Bio-Mechanically Engineered Design
Low Observable

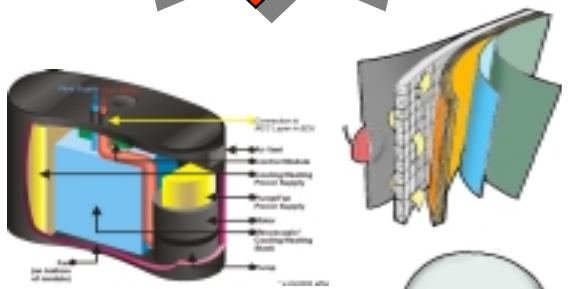
Enabled by Active Devices
Miniature Ventilation, Cooling & Heating
Multi-Functional, Hybrid Power
Embedded Micro-Sensors & Electro-Textiles
Integrated Water Solutions

Advanced Materials
Revolutionary Nano-Materials
Ultra-Light, Multi-Functional Innovation
Smart Structures
Affordable, Durable, Flexible

Unmatched, Full Spectrum Survivability

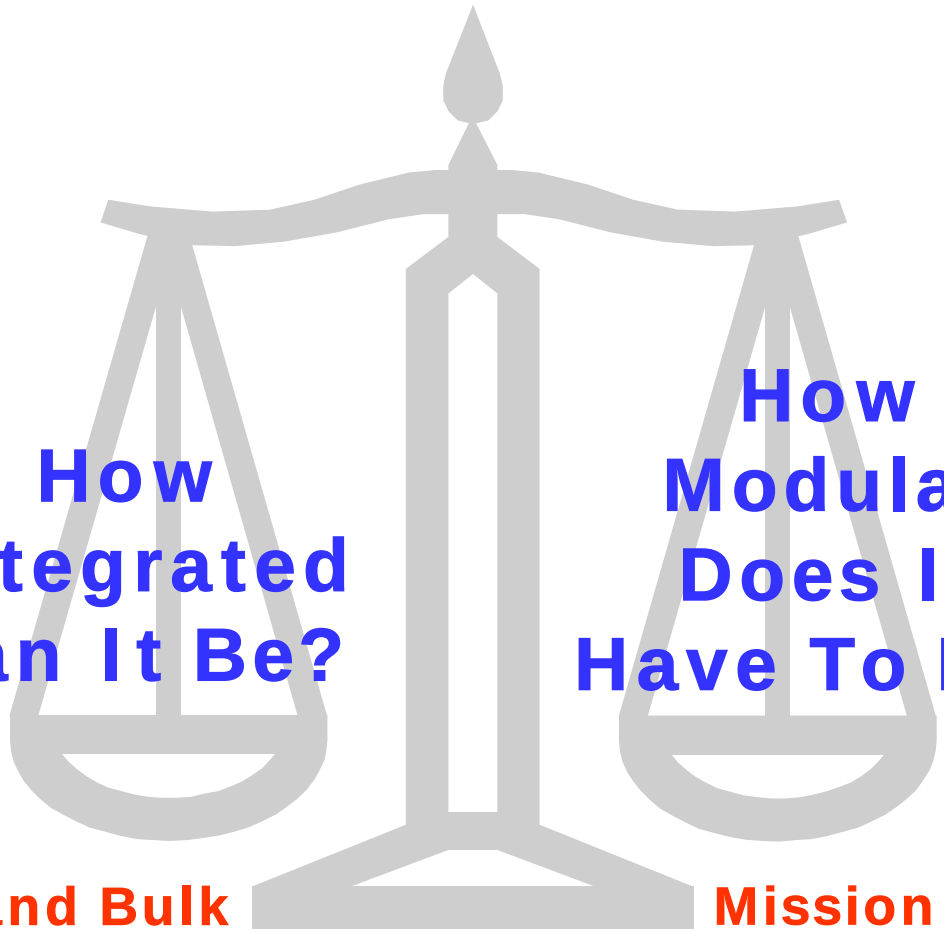
Foundation for Ultra-Light, Low Bulk Systems





Overmatching Physical/Mental Agility & Endurance

The Real Questions:



How Integrated Can It Be?

How Modular Does It Have To Be?

Weight and Bulk

Mission Flexibility
Technology Upgrades

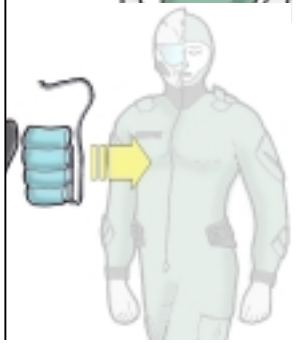
Scorpion
Conceptual Platform Features

- **Consciously designed "Integration Platform"**
- **Apply lightweight materials technologies**
  - e.g., Nano-technology, advanced ballistic protection
- **Combine Chemical/Biological and Environmental (cold, rain, snow, wind) protection into a single ensemble**
  - Durable, abrasion resistant, waterproof
  - Augment C/B protection & decontamination with emerging skin creams
  - Eliminate need for separate chemical and wet weather ensembles
- **Improve Signature Management**
  - Improved Visual & Near IR Camouflage
  - Thermal Signature Management

Potential 60% Weight Savings from Integration of Chemical, Biological & Wet Weather Protective Technologies

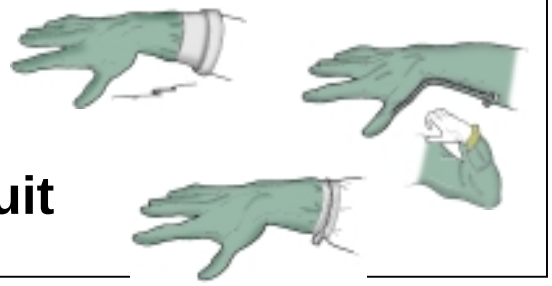
Scorpion
Conceptual Platform Features

- **Integrate armor and load carriage capabilities into combat ensemble**
  - 25-45% weight reduction against current conventional threats
  - Load carriage design based on biomechanical and human performance data
  - Improved Fightability
- **Razor-Back multi-functional element**
  - Rifle protection, back support & comfort, load bearing stability & interfaces with family of back packs & cooling/heating system
- **Configurable personal load vest system**
  - Soft/hard armor for front abdomen integrated with load vest
  - Baffled water carriage bladders embedded in vest
- **Advanced modular combat footwear**
  - Embedded work rate sensor
  - Heel strike energy generation

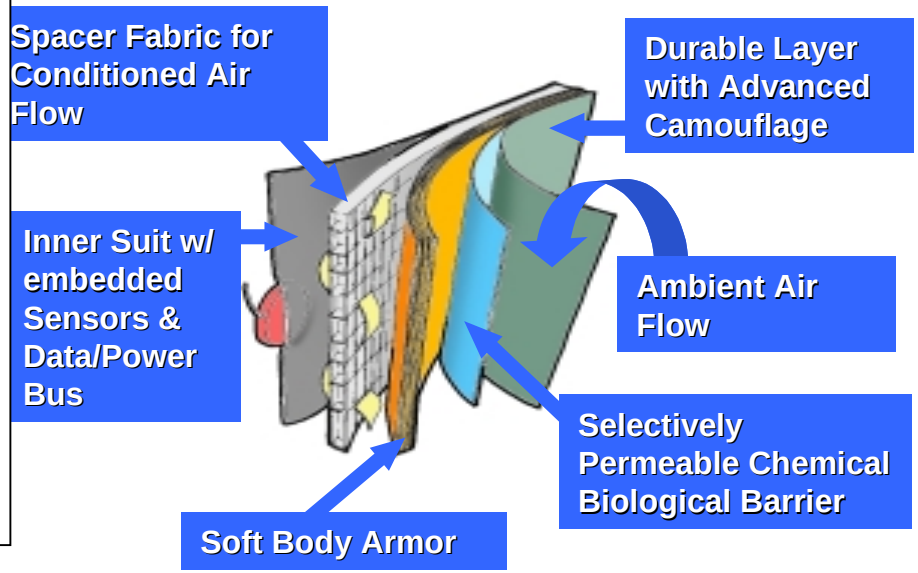


Scorpion
Conceptual Platform Features

- **"Quick-seal" chemical interfaces with mask, gloves & boots**
  - *"Soldier Keeps Dry in a Swamp"*
- **Conditioned air flows beneath outer suit**
- **Integrated waste elimination**
- **Close fitting (elastomeric) one piece inner suit**



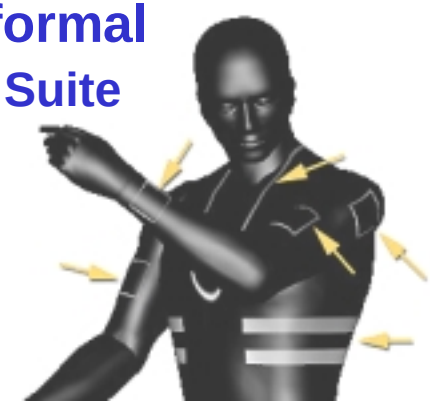
- Breathable, moisture-wicking, launderable
- Integrated physiological & medical sensors
- Conductive or Fiber Optic fibers for Data & Power Distribution
- Carbon Fiber Heating at wrists, kidneys and ankles
- Impact pads integrated at ~~knees and elbows~~
  - Hard caps Snap-On to outer suit

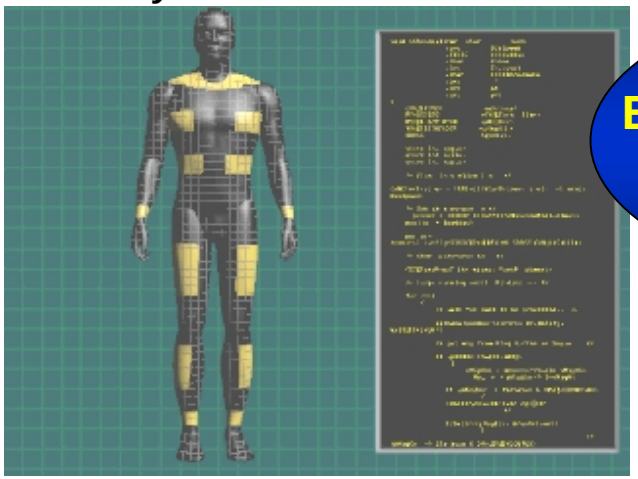


Scorpion
Conceptual Platform Features

- **Integrated Personal Area Network (IPAN) Data and Power Bus**
  - IEEE1394 Firewire
  - Blue Tooth Wireless Body LAN
  - Hybrid Firewire & Wireless LAN

Body Conformal Antennae Suite





Electromagnetic shielding for human and equipment

Photovoltaic technology for power generation/storage

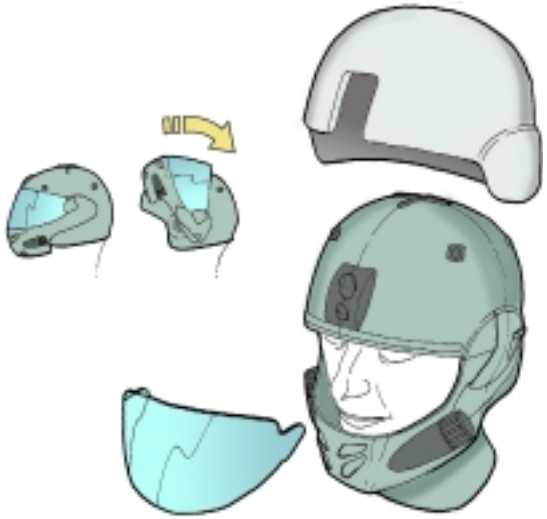
Physiological Status Monitoring

- Hydration state
- Thermal stress
- Energy balance
- Sleep status and performance
- Psychological status
- Fatigue (physical and cognitive)

Scorpion
Conceptual Platform Features

- Air Flow, Water, Video, Power & Data

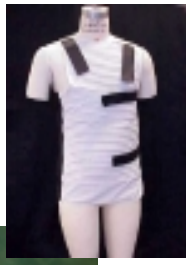
- Uniform Chemical Seal Interface with Helmet, Neck, & Mask



- Modular Ballistic Protection & Respiratory Mask Integration

Scorpion
Conceptual Platform Features

- **Microclimate Conditioning (MCC) System:**
  - Miniaturized Vapor Compression Cooling
  - Air Ventilation & Resistive Heating
  - Advanced Fuel Cell
  - Ergonomic Design
- **Significant mission benefits**
  - Longer mission time (endurance) in hot, and/or C/B environments
  - Improved soldier performance, both physical and cognitive – Combat Overmatch
  - Reduced heat stress casualties
  - Reduced water intake requirements
    - Weight Savings up to 30%
  - Enhance cold weather protection – potential to reduce weight/bulk

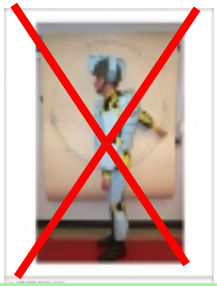


Current Cooling System Prototype

Potential weight reduction from 26 to 12 pounds by 2005

Integrated Designs, Virtual & Physical Prototypes, Field Demonstrations

From…



Hand Cutting And Placement Of Component Mock-ups to...

Through…

Virtual Prototype Form, Fit, Function Prior to Breadboard Prototyping

To…

Robust, Platoon Level Field Demonstration

Reduced Risk Breadboards, Brassboards, Field Tests of Integrated "System of Systems"

Human Performance Data
- Injury Mechanisms
- Component Mass Properties
- Mobility As a Function of Load and Load Carriage Equipment
- Biomechanics of Fatigue and Individual Movement

Interaction of Human Body, System Equipment & Combat Performance

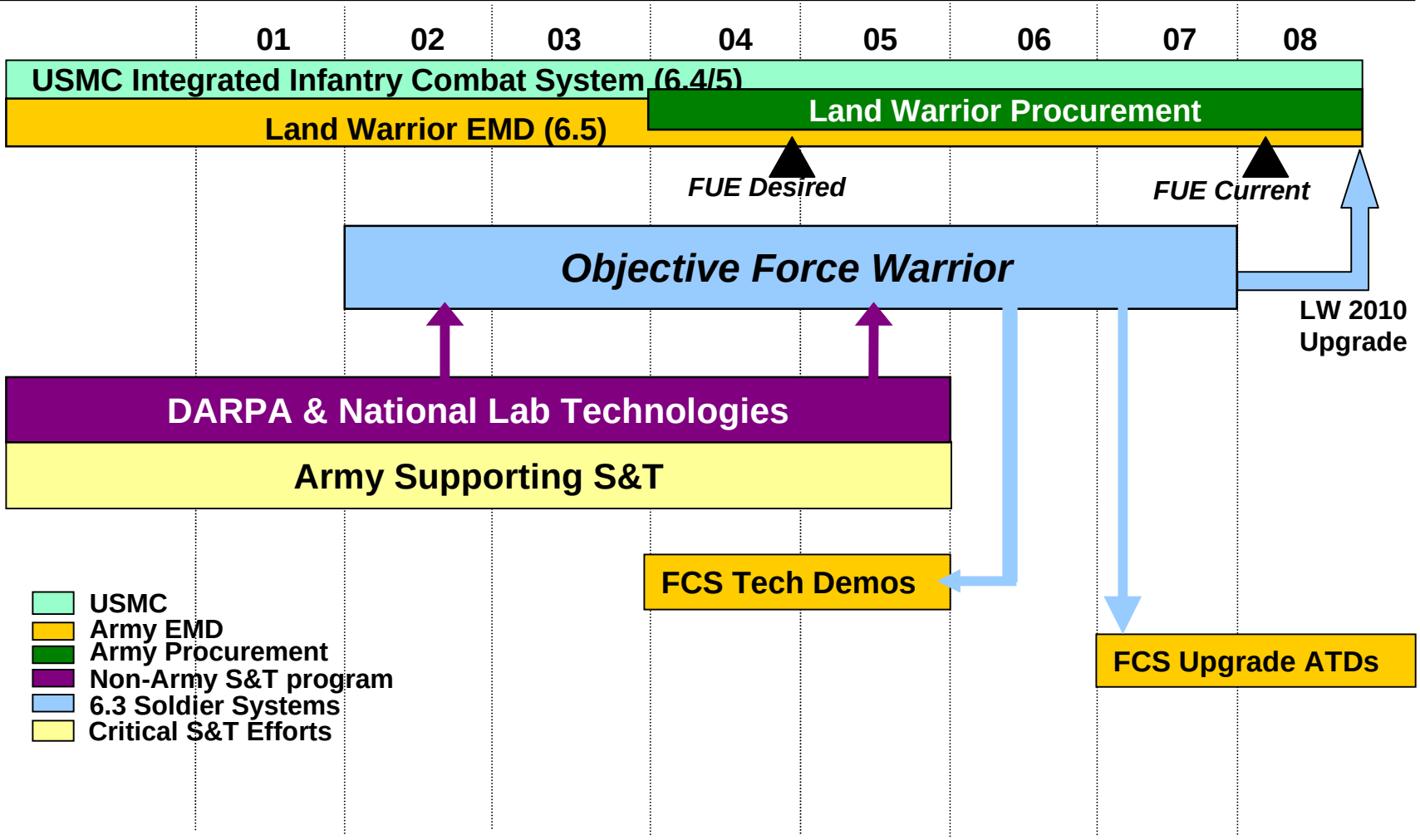
Infantry Warrior Virtual Prototype Simulation
- Bio-mechanic Simulation Tool
- Analysis of Human and Equipment Performance Under Realistic Use Conditions.

Objective Force Warrior

Technology Transition

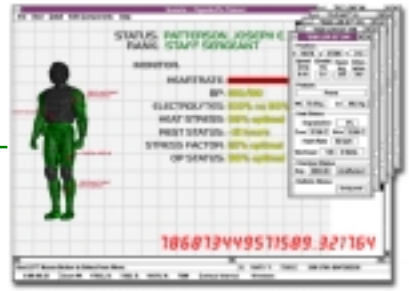
- **PM Soldier Systems Acquisition Strategy calls for Land Warrior Upgrades in FY06 (Version 3.0) and FY09 (Version 4.0)**
  - **Objective Force Warrior ATD transition to Land Warrior version 4.0 in FY08**
- **Future Requirements documented in TRADOC PAM 525-66, Land Warrior ORD, Soldier System MNS and Soldier System CRD Justify Transitions**
- **PM Soldier Systems has clearly stated the need for these technologies to meet Future Requirements**
  - **Coordinated Budget & Program Planning will ensure Smooth Transition in FY08**

Objective Force Warrior
Roadmap



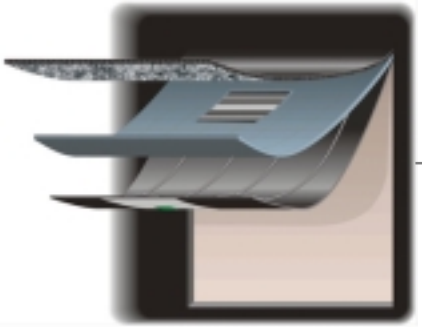
How can Nanoscience Enable the Future Warrior?

Helmet Subsystem

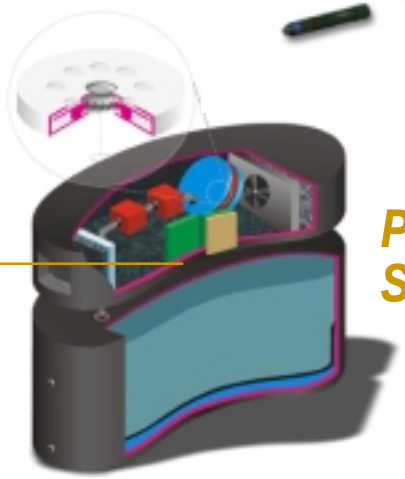


Biomedical Monitoring Subsystem

Weapon Subsystem



Multifunctional Uniform Subsystem



Power Subsystem

Nutrient/Aerial Delivery Systems

How can Nanoscience Enable the Future Warrior?

- Multifunctional Protection Capabilities/Technologies
- Reactive / Smart Materials
- Embedded Electronics Network (data/power)
- Signature Management
- Electromagnetic Shielding
- Power Generation/Storage
- Nano and Embedded Sensors
- Self-Mending Functions
- See-through Displays
- Thermal Stability Aids
- Agile Laser Eye Protection
- Durable, Affordable Materials